

GLOBAL PRECIPITATION MEASUREMENT PRECIPITATION PROCESSING SYSTEM

**File Specification
1CAMSR2**

Preliminary Version

February 14, 2014

0.1 1CAMSR2 - Common Calibrated Brightness Temperature

1CAMSR2 contains common calibrated brightness temperature from the AMSR2 passive microwave instrument flown on the GCOMW1 satellite. This products contains 6 swaths. Swath 1 has channels 10.65V 10.65H. Swath 2 has channels 18.7V 18.7H. Swath 3 has channels 23.8V 23.8H. Swath 4 has channels 36.5V 36.5H. Swath S5 has 2 high frequency A-Scan channels (89V 89H). Swath S6 has 2 high frequency B-Scan channels (89V 89H). Data for all six swaths is observed in the same revolution of the instrument. High frequency A and high frequency B data are observed in separate feedhorns.

RELATION BETWEEN THE SWATHS: Each S1 scan contains 10 GHz channels sampled 243 times along the scan. S2, S3, and S4 are sampled nominally at the same position as the S1 samples, but differ by small distances. Each S5 scan contains high frequency A channels sampled 486 times along the scan. Each S6 scan contains high frequency B channels sampled 486 times along the scan. Both Swath S5 and Swath S6 have exactly twice as many pixels as Swath S1. S1 pixels 1, 2, 3, ... coincide with S5 pixels 1, 3, 5, ... Scans of all swaths are repeated every 1.5s and the scans of one swath are about 10km apart along the direction of the satellite track. Along an S1 scan every other center of an S5 pixel coincides with the center of an S1 pixel, but the S6 pixels are offset from S1 and S2 pixels by nominally 15km in the direction normal to the scan direction on the aft side, in other words S6 pixels are nominally 15km "behind" the S1 and S5 pixels for the same scan.

The Figure below shows the locations of the pixels of scans 1 and 2 for swaths S1, S5, and S6. Since swaths S2, S3 and S4 are close to S1, they are omitted from the figure. Each "+" represents centers of pixels from one or more swaths. For example, the label "S1:1,2 S5:1,3" means that both Swath S1, Scan 1, Pixel 2 and Swath S5, Scan 1, Pixel 3 are located at the "+".

S6:1,1		S6:1,2		S6:1,3		.....		S6:1,391		S6:1,392
+		+		+				+		+
S6:2,1		S6:2,2		S6:2,3		.....		S6:2,391		S6:2,392
+		+		+				+		+
S1:1,1	S5:1,1	S5:1,2	S1:1,2	S5:1,3		.....		S1:1,196	S5:1,391	S5:1,392
+		+		+				+		+
S1:2,1	S5:2,1	S5:2,2	S1:2,2	S5:2,3		.....		S1:2,196	S5:2,391	S5:2,392
+		+		+				+		+

KNOWN PROBLEMS OR ISSUES :

None

Dimension definitions:

nscan1	var	Number of scans in Swath S1 in the granule.
nscan2	var	Number of scans in Swath S2 in the granule.
nscan3	var	Number of scans in Swath S3 in the granule.
nscan4	var	Number of scans in Swath S4 in the granule.
nscan5	var	Number of scans in Swath S5 in the granule.
nscan6	var	Number of scans in Swath S6 in the granule.
npixel1	243	Number of Swath S1 pixels in one scan.
npixel2	243	Number of Swath S2 pixels in one scan.
npixel3	243	Number of Swath S3 pixels in one scan.
npixel4	243	Number of Swath S4 pixels in one scan.
npixel5	486	Number of Swath S5 pixels in one scan.
npixel6	486	Number of Swath S6 pixels in one scan.
nchannel1	2	Number of Swath S1 channels.
nchannel2	2	Number of Swath S2 channels.
nchannel3	2	Number of Swath S3 channels.
nchannel4	2	Number of Swath S4 channels.
nchannel5	2	Number of Swath S5 channels.
nchannel6	2	Number of Swath S6 channels.
nchUIA1	1	Number of Swath S1 unique incidence angles.
nchUIA2	1	Number of Swath S2 unique incidence angles.
nchUIA3	1	Number of Swath S3 unique incidence angles.
nchUIA4	1	Number of Swath S4 unique incidence angles.
nchUIA5	1	Number of Swath S5 unique incidence angles.
nchUIA6	1	Number of Swath S6 unique incidence angles.

Figure 1 through Figure 19 show the structure of this product. The text below describes the contents of objects in the structure, the C Structure Header File and the Fortran Structure Header File.

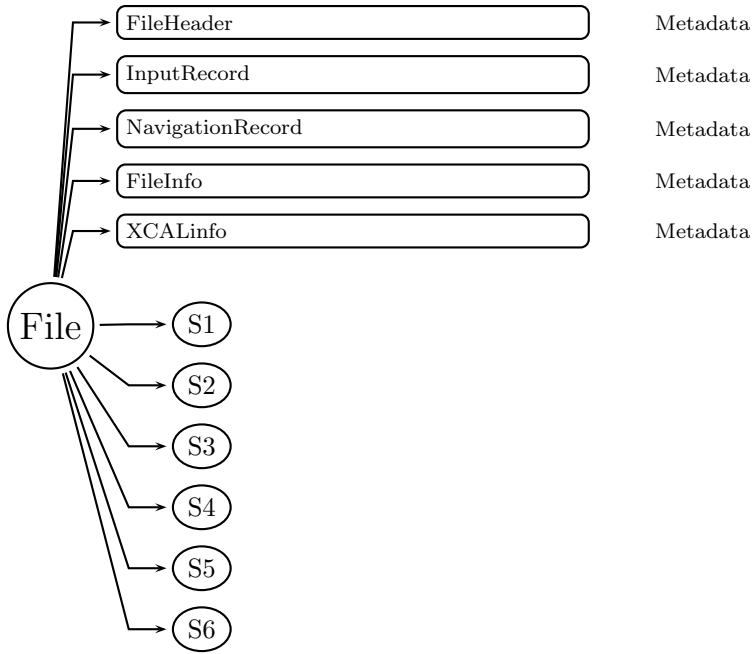


Figure 1: Data Format Structure for 1CAMSR2, Common Calibrated Brightness Temperature

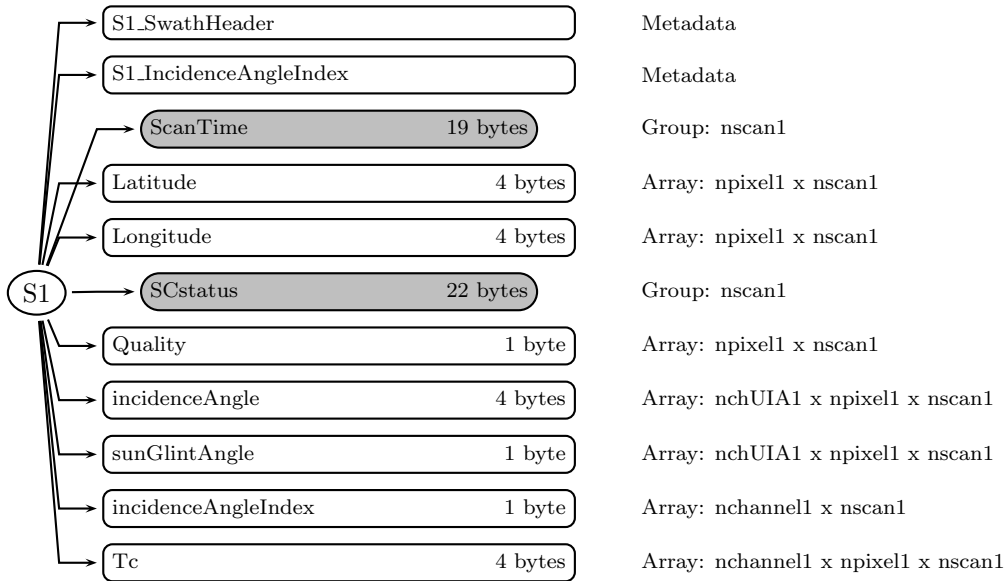


Figure 2: Data Format Structure for 1CAMSR2, S1

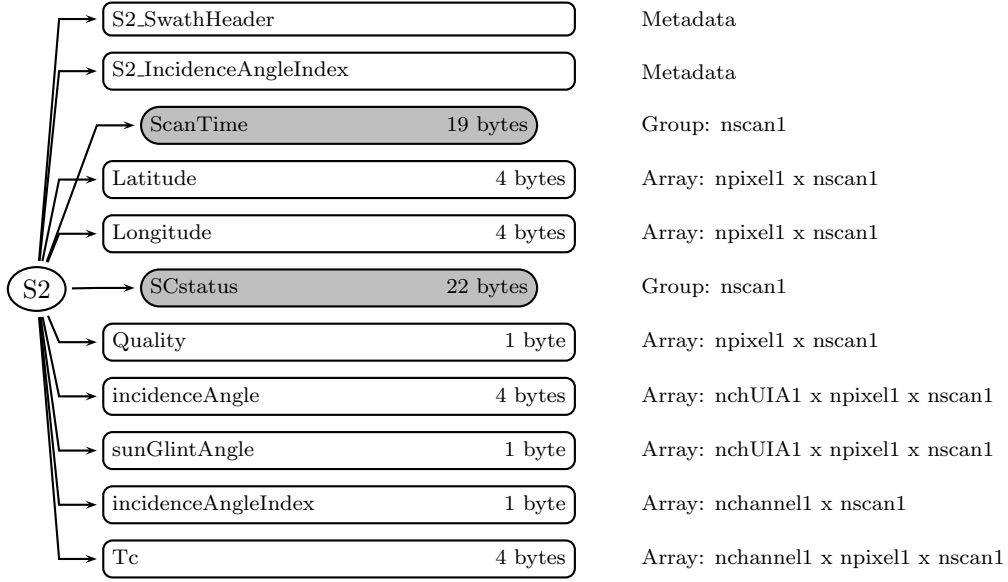


Figure 3: Data Format Structure for 1CAMSR2, S2

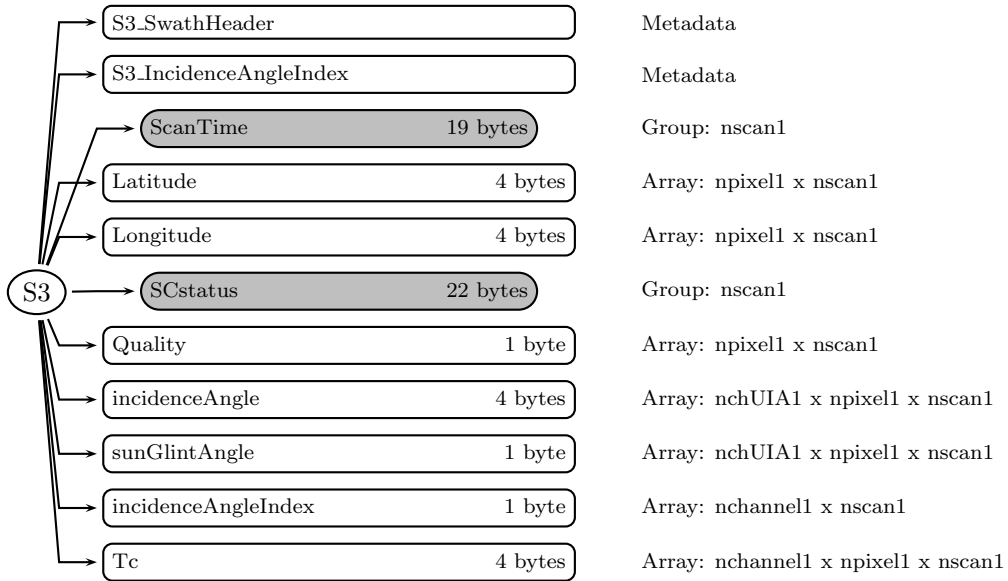


Figure 4: Data Format Structure for 1CAMSR2, S3

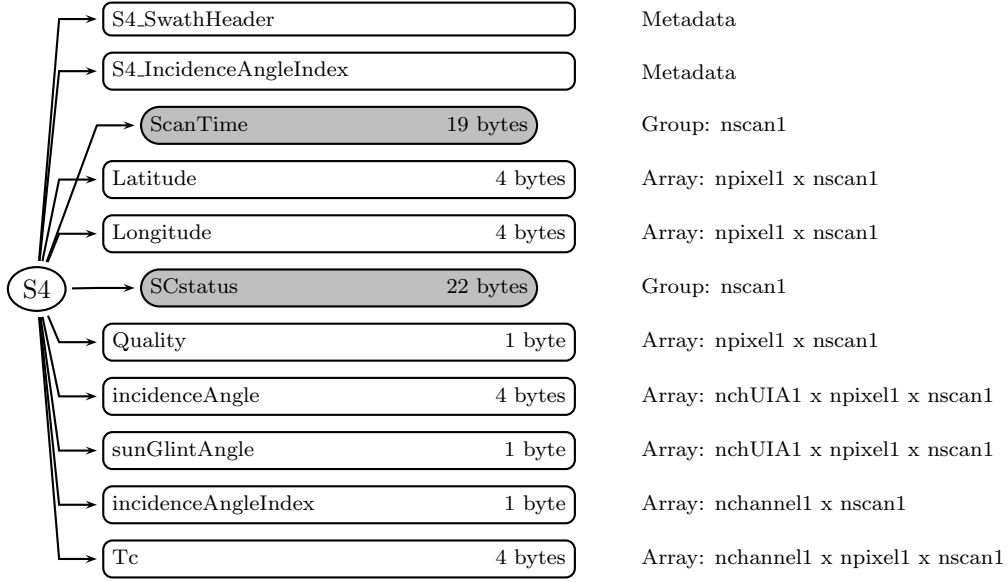


Figure 5: Data Format Structure for 1CAMSR2, S4

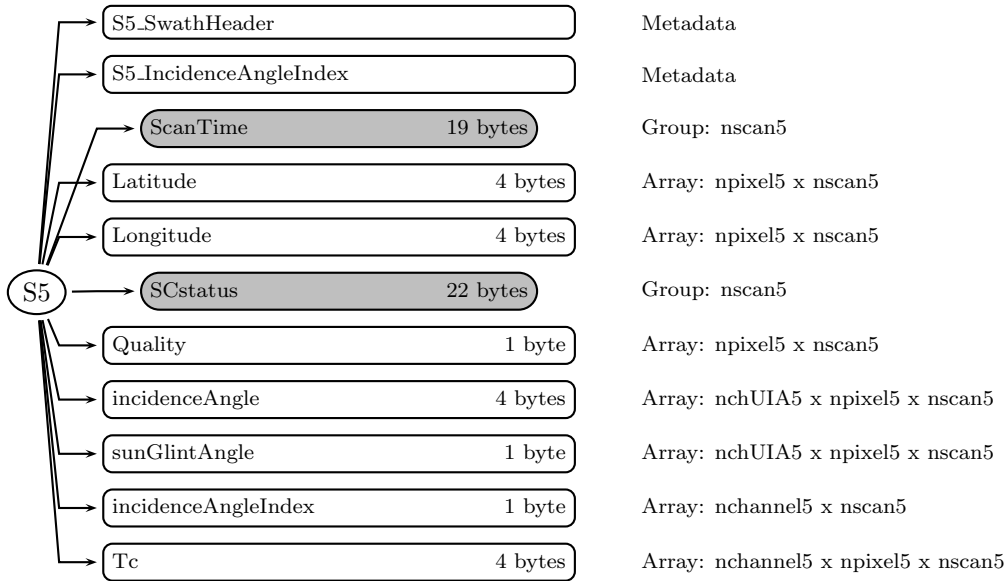


Figure 6: Data Format Structure for 1CAMSR2, S5

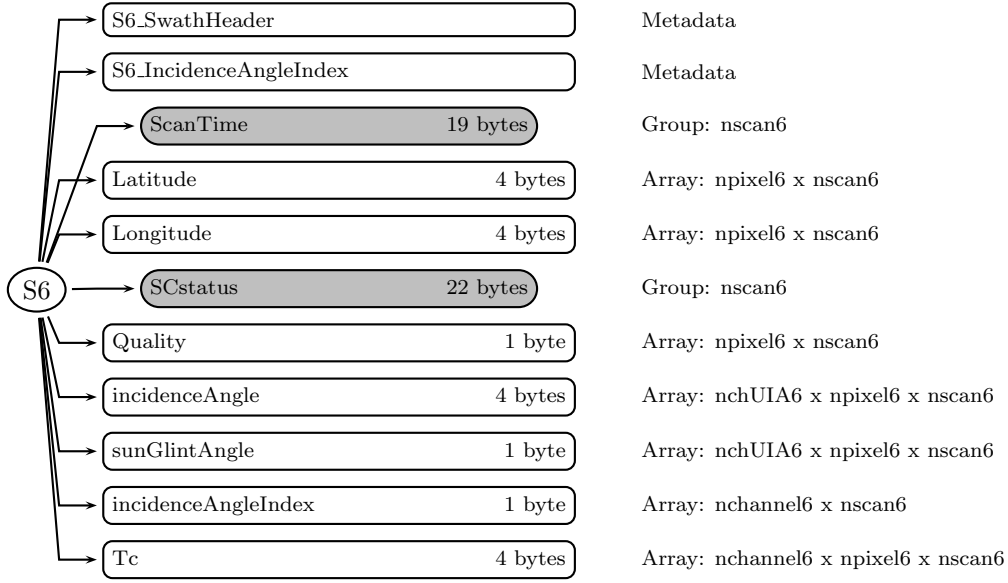


Figure 7: Data Format Structure for 1CAMSR2, S6

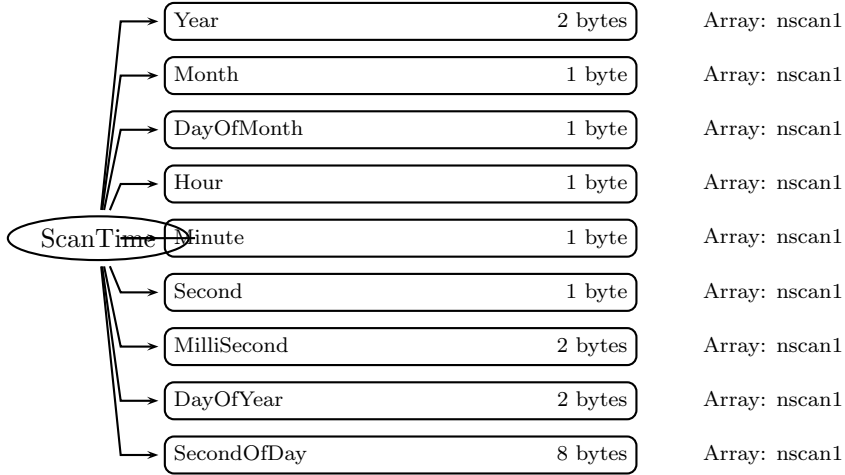


Figure 8: Data Format Structure for 1CAMSR2, S1, ScanTime

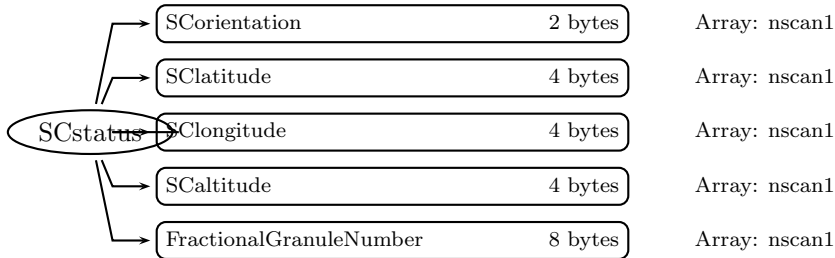


Figure 9: Data Format Structure for 1CAMSR2, S1, SCstatus

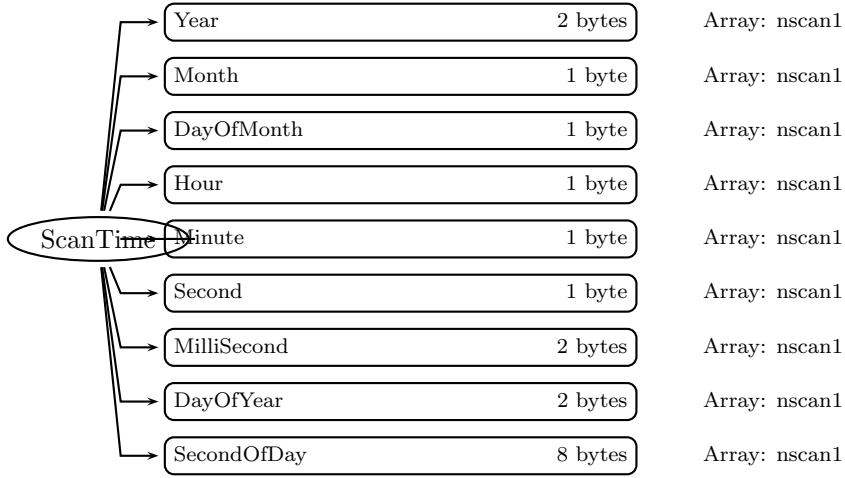


Figure 10: Data Format Structure for 1CAMSR2, S2, ScanTime

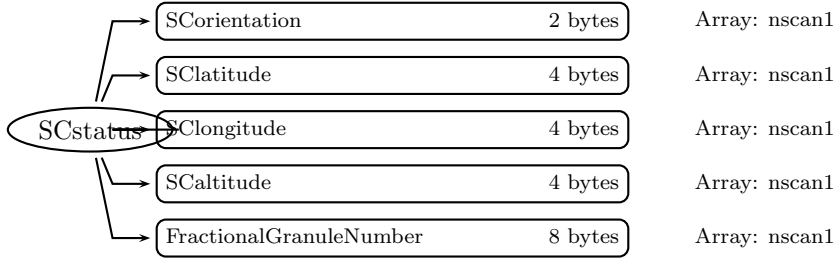


Figure 11: Data Format Structure for 1CAMSR2, S2, SCstatus

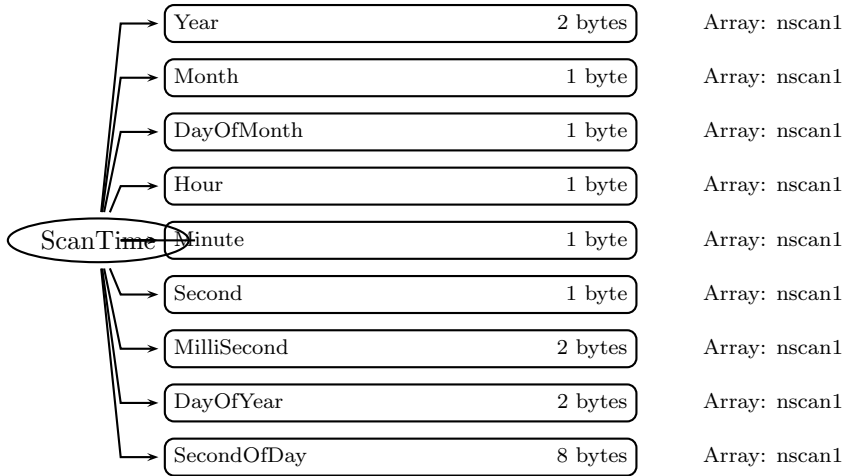


Figure 12: Data Format Structure for 1CAMSR2, S3, ScanTime

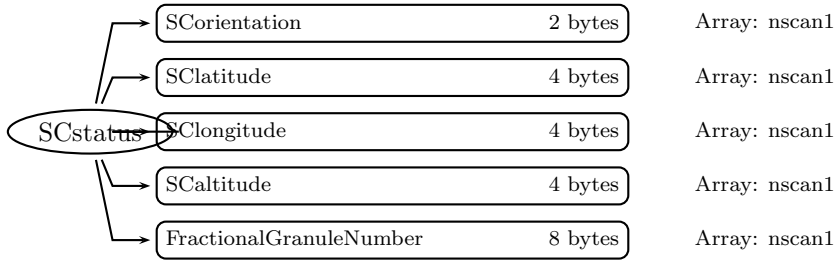


Figure 13: Data Format Structure for 1CAMSR2, S3, SCstatus



Figure 14: Data Format Structure for 1CAMSR2, S4, ScanTime

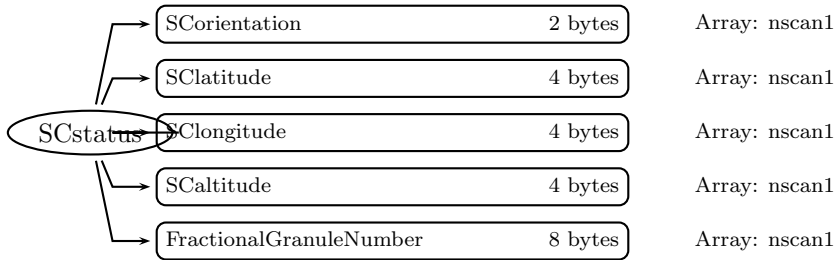


Figure 15: Data Format Structure for 1CAMSR2, S4, SCstatus



Figure 16: Data Format Structure for 1CAMSR2, S5, ScanTime

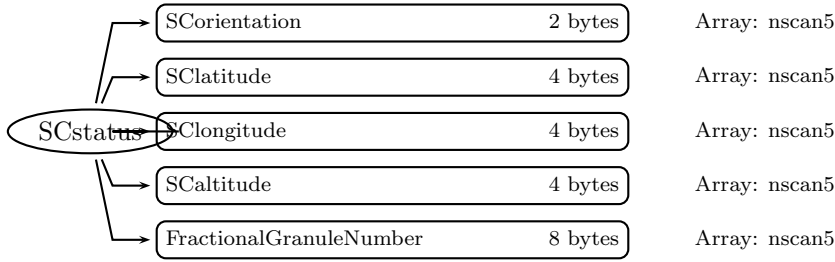


Figure 17: Data Format Structure for 1CAMS2, S5, SCstatus



Figure 18: Data Format Structure for 1CAMS2, S6, ScanTime

FileHeader (Metadata):

FileHeader contains general metadata. This group appears in all data products. See Metadata for GPM Products for details.

InputRecord (Metadata):

InputRecord contains a record of input files for this granule. This group appears in Level 1 and Level 2 data products. Level 3 time averaged products have the same information separated into 3 groups since they have many inputs. See Metadata for GPM Products for details.

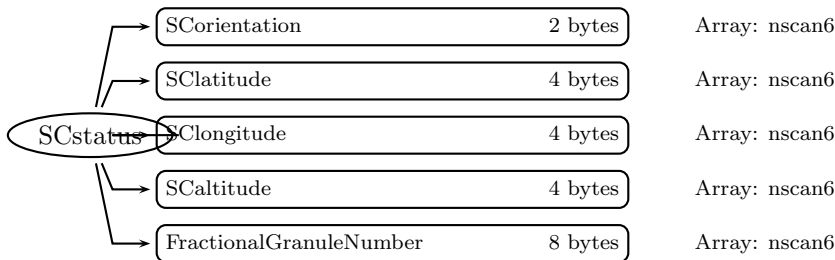


Figure 19: Data Format Structure for 1CAMS2, S6, SCstatus

NavigationRecord (Metadata):

NavigationRecord contains navigation metadata for this granule. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

FileInfo (Metadata):

FileInfo contains metadata used by the PPS I/O Toolkit (TKIO). This group appears in all data products. See Metadata for GPM Products for details.

XCALinfo (Metadata):

XCALinfo contains metadata required by 1C intercalibrated files. See Metadata for GPM Products for details.

S1 (Swath)**S1_SwathHeader** (Metadata):

SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S1_IncidenceAngleIndex (Metadata):

IncidenceAngleIndex contains a list of indices of the incidence angle array and sun glint angle array. See the description of the data array incidenceAngleIndex for details.

ScanTime (Group in S1)**Year** (2-byte integer, array size: nscan1):

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: nscan1):

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: nscan1):

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: nscan1):

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan1):

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan1):

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan1):

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:
-9999 Missing value

DayOfYear (2-byte integer, array size: nscan1):

Day of the year. Values range from 1 to 366 days. Special values are defined as:
-9999 Missing value

SecondOfDay (8-byte float, array size: nscan1):

A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:
-9999.9 Missing value

Latitude (4-byte float, array size: npixel1 x nscan1):

Nominal latitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

Longitude (4-byte float, array size: npixel1 x nscan1):

Nominal longitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

SCstatus (Group in S1)

SCorientation (2-byte integer, array size: nscan1):

The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:

-9999 Missing value

SClatitude (4-byte float, array size: nscan1):

Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

SClongitude (4-byte float, array size: nscan1):

Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan1):

Values range from 0 to 1000 km. Special values are defined as:

-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan1):

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:

-9999.9 Missing value

Quality (1-byte integer, array size: npixel1 x nscan1):

Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

- 0 = Good data in all channels in the swath
- 1 = Possible sun glint
- 2 = Climatology QC check warning
- 10 = Data is missing from input file or unreadable
- 20 = Geolocation check flagged pixel as bad
- 30 = Climatology check flagged pixel as bad
- 40 = Distance between pixels is nonphysical
- 50 = Antenna temperatures are less than 50 K or greater than 325 K
- 60 = Lat/lon values are out of range
- 70 = Adjacent/cross-pol pixel flagged as bad

incidenceAngle (4-byte float, array size: nchUIA1 x npixel1 x nscan1):

Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:
-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA1 x npixel1 x nscan1):

Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel1 x nscan1):

Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

```
incidenceAngle(2,npixel,nscan)
sunGlintAngle(2,npixel,nscan)
incidenceAngleIndex(10,nscan)
Tc(10,npixel,nscan)
```

The user would do the following to retrieve the angles
for a given channel, pixel, and scan:

```
i = incidenceAngleIndex(channel,scan)
ia = incidenceAngle(i,pixel,scan)
```

```
sga = sunGlintAngle(i,pixel,scan)
```

The `incidenceAngleIndex` is the same for every scan, but is repeated each scan for the convenience of users reading the data scan by scan. In addition, `incidenceAngleIndex` is located in metadata for the convenience of users wishing to read this information from metadata.

Values range from 0 to 100. Special values are defined as:

-99 Missing value

Tc (4-byte float, array size: `nchannel1` x `npixel1` x `nscan1`):

GPM Common Calibrated Brightness Temperature. The channels are:

10.65 GHz vertically-polarized TBs

10.65 GHz horizontally-polarized TBs

S2 (Swath)

S2_SwathHeader (Metadata):

SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S2_IncidenceAngleIndex (Metadata):

IncidenceAngleIndex contains a list of indices of the incidence angle array and sun glint angle array. See the description of the data array `incidenceAngleIndex` for details.

ScanTime (Group in S2)

Year (2-byte integer, array size: `nscan1`):

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: `nscan1`):

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: `nscan1`):

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: `nscan1`):

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan1):

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan1):

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan1):

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999 Missing value

DayOfYear (2-byte integer, array size: nscan1):

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999 Missing value

SecondOfDay (8-byte float, array size: nscan1):

A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9 Missing value

Latitude (4-byte float, array size: npixel1 x nscan1):

Nominal latitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

Longitude (4-byte float, array size: npixel1 x nscan1):

Nominal longitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

SCstatus (Group in S2)

SCorientation (2-byte integer, array size: nscan1):

The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:

-9999 Missing value

SClatitude (4-byte float, array size: nscan1):

Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

SClongitude (4-byte float, array size: nscan1):

Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan1):

Values range from 0 to 1000 km. Special values are defined as:

-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan1):

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:

-9999.9 Missing value

Quality (1-byte integer, array size: npixel1 x nscan1):

Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

0 = Good data in all channels in the swath
1 = Possible sun glint
2 = Climatology QC check warning
10 = Data is missing from input file or unreadable
20 = Geolocation check flagged pixel as bad
30 = Climatology check flagged pixel as bad
40 = Distance between pixels is nonphysical
50 = Antenna temperatures are less than 50 K or greater than 325 K
60 = Lat/lon values are out of range
70 = Adjacent/cross-pol pixel flagged as bad

incidenceAngle (4-byte float, array size: nchUIA1 x npixel1 x nscan1):

Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:

-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA1 x npixel1 x nscan1):

Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel1 x nscan1):

Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

```
incidenceAngle(2,npixel,nscan)  
sunGlintAngle(2,npixel,nscan)  
incidenceAngleIndex(10,nscan)  
Tc(10,npixel,nscan)
```

The user would do the following to retrieve the angles for a given channel, pixel, and scan:

```
i = incidenceAngleIndex(channel,scan)
ia = incidenceAngle(i,pixel,scan)
sga = sunGlintAngle(i,pixel,scan)
```

The `incidenceAngleIndex` is the same for every scan, but is repeated each scan for the convenience of users reading the data scan by scan. In addition, `incidenceAngleIndex` is located in metadata for the convenience of users wishing to read this information from metadata.

Values range from 0 to 100. Special values are defined as:

-99 Missing value

Tc (4-byte float, array size: `nchannel1` x `npixel1` x `nscan1`):

GPM Common Calibrated Brightness Temperature. The channels are:

18.7 GHz vertically-polarized TBs

18.7 GHz horizontally-polarized TBs

S3 (Swath)

S3.SwathHeader (Metadata):

SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S3.IncidenceAngleIndex (Metadata):

IncidenceAngleIndex contains a list of indices of the incidence angle array and sun glint angle array. See the description of the data array `incidenceAngleIndex` for details.

ScanTime (Group in S3)

Year (2-byte integer, array size: `nscan1`):

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: `nscan1`):

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: nscan1):

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: nscan1):

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan1):

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan1):

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan1):

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999 Missing value

DayOfYear (2-byte integer, array size: nscan1):

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999 Missing value

SecondOfDay (8-byte float, array size: nscan1):

A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9 Missing value

Latitude (4-byte float, array size: npixel1 x nscan1):

Nominal latitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

Longitude (4-byte float, array size: npixel1 x nscan1):

Nominal longitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

SCstatus (Group in S3)

SCorientation (2-byte integer, array size: nscan1):

The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:

-9999 Missing value

SClatitude (4-byte float, array size: nscan1):

Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

SClongitude (4-byte float, array size: nscan1):

Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan1):

Values range from 0 to 1000 km. Special values are defined as:

-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan1):

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule.

Values range from 0 to 100000. Special values are defined as:

-9999.9 Missing value

Quality (1-byte integer, array size: npixel1 x nscan1):

Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

0 = Good data in all channels in the swath

1 = Possible sun glint

2 = Climatology QC check warning

10 = Data is missing from input file or unreadable

20 = Geolocation check flagged pixel as bad

30 = Climatology check flagged pixel as bad

40 = Distance between pixels is nonphysical

50 = Antenna temperatures are less than 50 K or greater than 325 K

60 = Lat/lon values are out of range

70 = Adjacent/cross-pol pixel flagged as bad

incidenceAngle (4-byte float, array size: nchUIA1 x npixel1 x nscan1):

Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:

-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA1 x npixel1 x nscan1):

Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel1 x nscan1):

Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and

2 unique incidence angles, then the dimensions in Fortran would be:

```
incidenceAngle(2,npixel,nscan)
sunGlintAngle(2,npixel,nscan)
incidenceAngleIndex(10,nscan)
Tc(10,npixel,nscan)
```

The user would do the following to retrieve the angles for a given channel, pixel, and scan:

```
i = incidenceAngleIndex(channel,scan)
ia = incidenceAngle(i,pixel,scan)
sga = sunGlintAngle(i,pixel,scan)
```

The `incidenceAngleIndex` is the same for every scan, but is repeated each scan for the convenience of users reading the data scan by scan. In addition, `incidenceAngleIndex` is located in metadata for the convenience of users wishing to read this information from metadata.

Values range from 0 to 100. Special values are defined as:
-99 Missing value

Tc (4-byte float, array size: `nchannel1 x npixel1 x nscan1`):
GPM Common Calibrated Brightness Temperature. The channels are:

23.8	GHz vertically-polarized	TBs
23.8	GHz horizontally-polarized	TBs

S4 (Swath)

S4_SwathHeader (Metadata):

SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S4_IncidenceAngleIndex (Metadata):

IncidenceAngleIndex contains a list of indices of the incidence angle array and sun glint angle array. See the description of the data array `incidenceAngleIndex` for details.

ScanTime (Group in S4)

Year (2-byte integer, array size: nscan1):

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: nscan1):

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: nscan1):

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: nscan1):

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan1):

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan1):

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan1):

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999 Missing value

DayOfYear (2-byte integer, array size: nscan1):

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999 Missing value

SecondOfDay (8-byte float, array size: nscan1):

A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9 Missing value

Latitude (4-byte float, array size: npixel1 x nscan1):

Nominal latitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

Longitude (4-byte float, array size: npixel1 x nscan1):

Nominal longitude of the observation point on the earth surface at low frequency. This was calculated by applying the 23 GHz coregistration parameters to the 89A GHz location.

SCstatus (Group in S4)

SCorientation (2-byte integer, array size: nscan1):

The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined

in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:

-9999 Missing value

SCLatitude (4-byte float, array size: nscan1):

Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

SCLongitude (4-byte float, array size: nscan1):

Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCAltitude (4-byte float, array size: nscan1):

Values range from 0 to 1000 km. Special values are defined as:

-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan1):

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule.

Values range from 0 to 100000. Special values are defined as:

-9999.9 Missing value

Quality (1-byte integer, array size: npixel1 x nscan1):

Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

0 = Good data in all channels in the swath

1 = Possible sun glint

2 = Climatology QC check warning

10 = Data is missing from input file or unreadable

20 = Geolocation check flagged pixel as bad

30 = Climatology check flagged pixel as bad

40 = Distance between pixels is nonphysical

50 = Antenna temperatures are less than 50 K or greater than 325 K

60 = Lat/lon values are out of range

70 = Adjacent/cross-pol pixel flagged as bad

incidenceAngle (4-byte float, array size: nchUIA1 x npixel1 x nscan1):

Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:

-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA1 x npixel1 x nscan1):

Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel1 x nscan1):

Index (1 based as in Fortran) of the incidence angle array corresponding to the channel. For example, if the swath has 10 channels and 2 unique incidence angles, then the dimensions in Fortran would be:

```
incidenceAngle(2,npixel,nscan)
sunGlintAngle(2,npixel,nscan)
incidenceAngleIndex(10,nscan)
Tc(10,npixel,nscan)
```

The user would do the following to retrieve the angles for a given channel, pixel, and scan:

```
i = incidenceAngleIndex(channel,scan)
ia = incidenceAngle(i,pixel,scan)
sga = sunGlintAngle(i,pixel,scan)
```

The incidenceAngleIndex is the same for every scan, but is repeated each scan for the convenience of users reading the data scan by scan. In addition, incidenceAngleIndex is located in metadata for the convenience of users wishing to read this information from metadata.

Values range from 0 to 100. Special values are defined as:

-99 Missing value

Tc (4-byte float, array size: nchannel1 x npixel1 x nscan1):

GPM Common Calibrated Brightness Temperature. The channels are:

```
36.5    GHz vertically-polarized    TBs
36.5    GHz horizontally-polarized TBs
```

S5 (Swath)

S5_SwathHeader (Metadata):

SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S5.IncidenceAngleIndex (Metadata):

IncidenceAngleIndex contains a list of indices of the incidence angle array and sun glint angle array. See the description of the data array incidenceAngleIndex for details.

ScanTime (Group in S5)**Year** (2-byte integer, array size: nscan5):

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: nscan5):

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: nscan5):

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: nscan5):

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan5):

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan5):

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan5):

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999 Missing value

DayOfYear (2-byte integer, array size: nscan5):

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999 Missing value

SecondOfDay (8-byte float, array size: nscan5):

A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9 Missing value

Latitude (4-byte float, array size: npixel5 x nscan5):

The earth latitude of the center of the IFOV at the altitude of the earth ellipsoid. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

Longitude (4-byte float, array size: npixel5 x nscan5):

The earth longitude of the center of the IFOV at the altitude of the earth ellipsoid. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCstatus (Group in S5)

SCorientation (2-byte integer, array size: nscan5):

The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:

-9999 Missing value

SClatitude (4-byte float, array size: nscan5):

Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

SClongitude (4-byte float, array size: nscan5):

Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan5):

Values range from 0 to 1000 km. Special values are defined as:

-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan5):

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:

-9999.9 Missing value

Quality (1-byte integer, array size: npixel5 x nscan5):

Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

0 = Good data in all channels in the swath

1 = Possible sun glint

2 = Climatology QC check warning

10 = Data is missing from input file or unreadable

20 = Geolocation check flagged pixel as bad

30 = Climatology check flagged pixel as bad

40 = Distance between pixels is nonphysical

50 = Antenna temperatures are less than 50 K or greater than 325 K
60 = Lat/lon values are out of range
70 = Adjacent/cross-pol pixel flagged as bad

incidenceAngle (4-byte float, array size: nchUIA5 x npixel5 x nscan5):

Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:
-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA5 x npixel5 x nscan5):

Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel5 x nscan5):

Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

```
incidenceAngle(2,npixel,nscan)  
sunGlintAngle(2,npixel,nscan)  
incidenceAngleIndex(10,nscan)  
Tc(10,npixel,nscan)
```

The user would do the following to retrieve the angles
for a given channel, pixel, and scan:

```
i = incidenceAngleIndex(channel,scan)  
ia = incidenceAngle(i,pixel,scan)  
sga = sunGlintAngle(i,pixel,scan)
```

The incidenceAngleIndex is the same for every scan,
but is repeated each scan for the convenience of users
reading the data scan by scan. In addition,
incidenceAngleIndex is located in metadata for the
convenience of users wishing to read this information
from metadata.

Values range from 0 to 100. Special values are defined as:
-99 Missing value

Tc (4-byte float, array size: nchannel5 x npixel5 x nscan5):
GPM Common Calibrated Brightness Temperature. The channels are:

89 GHz vertically-polarized TBs
89 GHz horizontally-polarized TBs

S6 (Swath)

S6.SwathHeader (Metadata):

SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S6.IncidenceAngleIndex (Metadata):

IncidenceAngleIndex contains a list of indices of the incidence angle array and sun glint angle array. See the description of the data array incidenceAngleIndex for details.

ScanTime (Group in S6)

Year (2-byte integer, array size: nscan6):

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: nscan6):

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: nscan6):

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: nscan6):

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan6):

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan6):

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan6):

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999 Missing value

DayOfYear (2-byte integer, array size: nscan6):

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999 Missing value

SecondOfDay (8-byte float, array size: nscan6):

A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9 Missing value

Latitude (4-byte float, array size: npixel6 x nscan6):

The earth latitude of the center of the IFOV at the altitude of the earth ellipsoid. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

Longitude (4-byte float, array size: npixel6 x nscan6):

The earth longitude of the center of the IFOV at the altitude of the earth ellipsoid. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCstatus (Group in S6)

SCorientation (2-byte integer, array size: nscan6):

The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:

-9999 Missing value

SClatitude (4-byte float, array size: nscan6):

Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

SClongitude (4-byte float, array size: nscan6):

Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan6):

Values range from 0 to 1000 km. Special values are defined as:

-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan6):

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:

-9999.9 Missing value

Quality (1-byte integer, array size: npixel6 x nscan6):

Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major

issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

- 0 = Good data in all channels in the swath
- 1 = Possible sun glint
- 2 = Climatology QC check warning
- 10 = Data is missing from input file or unreadable
- 20 = Geolocation check flagged pixel as bad
- 30 = Climatology check flagged pixel as bad
- 40 = Distance between pixels is nonphysical
- 50 = Antenna temperatures are less than 50 K or greater than 325 K
- 60 = Lat/lon values are out of range
- 70 = Adjacent/cross-pol pixel flagged as bad

incidenceAngle (4-byte float, array size: nchUIA6 x npixel6 x nscan6):

Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:
-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA6 x npixel6 x nscan6):

Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel6 x nscan6):

Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

```
incidenceAngle(2,npixel,nscan)
sunGlintAngle(2,npixel,nscan)
incidenceAngleIndex(10,nscan)
Tc(10,npixel,nscan)
```

The user would do the following to retrieve the angles
for a given channel, pixel, and scan:

```
i = incidenceAngleIndex(channel,scan)
ia = incidenceAngle(i,pixel,scan)
sga = sunGlintAngle(i,pixel,scan)
```

The incidenceAngleIndex is the same for every scan,

but is repeated each scan for the convenience of users reading the data scan by scan. In addition, incidenceAngleIndex is located in metadata for the convenience of users wishing to read this information from metadata.

Values range from 0 to 100. Special values are defined as:

-99 Missing value

Tc (4-byte float, array size: nchannel6 x npixel6 x nscan6):

GPM Common Calibrated Brightness Temperature. The channels are:

89 GHz vertically-polarized TBs

89 GHz horizontally-polarized TBs

C Structure Header file:

```
#ifndef _TK_1CAMSR2_H_
#define _TK_1CAMSR2_H_

#ifndef _L1CAMSR2_S6_
#define _L1CAMSR2_S6_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[486];
    float Longitude[486];
    SCSTATUS SCstatus;
    signed char Quality[486];
    float incidenceAngle[486][1];
    signed char sunGlintAngle[486][1];
    signed char incidenceAngleIndex[2];
    float Tc[486][2];
} L1CAMSR2_S6;

#endif

#ifndef _L1CAMSR2_S5_
#define _L1CAMSR2_S5_

typedef struct {
    SCANTIME ScanTime;
```



```

float Latitude[486];
float Longitude[486];
SCSTATUS SCstatus;
signed char Quality[486];
float incidenceAngle[486][1];
signed char sunGlintAngle[486][1];
signed char incidenceAngleIndex[2];
float Tc[486][2];
} L1CAMSR2_S5;

#endif

#ifndef _L1CAMSR2_S4_
#define _L1CAMSR2_S4_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[243];
    float Longitude[243];
    SCSTATUS SCstatus;
    signed char Quality[243];
    float incidenceAngle[243][1];
    signed char sunGlintAngle[243][1];
    signed char incidenceAngleIndex[2];
    float Tc[243][2];
} L1CAMSR2_S4;

#endif

#ifndef _L1CAMSR2_S3_
#define _L1CAMSR2_S3_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[243];
    float Longitude[243];
    SCSTATUS SCstatus;
    signed char Quality[243];
    float incidenceAngle[243][1];
    signed char sunGlintAngle[243][1];
    signed char incidenceAngleIndex[2];
    float Tc[243][2];
} L1CAMSR2_S3;

```

```

#endif

#ifndef _L1CAMSR2_S2_
#define _L1CAMSR2_S2_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[243];
    float Longitude[243];
    SCSTATUS SCstatus;
    signed char Quality[243];
    float incidenceAngle[243][1];
    signed char sunGlintAngle[243][1];
    signed char incidenceAngleIndex[2];
    float Tc[243][2];
} L1CAMSR2_S2;

#endif

#ifndef _SCSTATUS_
#define _SCSTATUS_

typedef struct {
    short SCorientation;
    float SClatitude;
    float SClongitude;
    float SCaltitude;
    double FractionalGranuleNumber;
} SCSTATUS;

#endif

#ifndef _SCANTIME_
#define _SCANTIME_

typedef struct {
    short Year;
    signed char Month;
    signed char DayOfMonth;
    signed char Hour;
    signed char Minute;
    signed char Second;

```

```

        short MilliSecond;
        short DayOfYear;
        double SecondOfDay;
    } SCANTIME;

#endif

#ifndef _L1CAMSR2_S1_
#define _L1CAMSR2_S1_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[243];
    float Longitude[243];
    SCSTATUS SCstatus;
    signed char Quality[243];
    float incidenceAngle[243][1];
    signed char sunGlintAngle[243][1];
    signed char incidenceAngleIndex[2];
    float Tc[243][2];
} L1CAMSR2_S1;

#endif

#ifndef _L1CAMSR2_SWATHS_
#define _L1CAMSR2_SWATHS_

typedef struct {
    L1CAMSR2_S1 S1;
    L1CAMSR2_S2 S2;
    L1CAMSR2_S3 S3;
    L1CAMSR2_S4 S4;
    L1CAMSR2_S5 S5;
    L1CAMSR2_S6 S6;
} L1CAMSR2_SWATHS;

#endif

#endif

```

Fortran Structure Header file:

```
STRUCTURE /L1CAMSR2_S6/
```

```

RECORD /SCANTIME/ ScanTime
REAL*4 Latitude(486)
REAL*4 Longitude(486)
RECORD /SCSTATUS/ SCstatus
BYTE Quality(486)
REAL*4 incidenceAngle(1,486)
BYTE sunGlintAngle(1,486)
BYTE incidenceAngleIndex(2)
REAL*4 Tc(2,486)
END STRUCTURE

```

```

STRUCTURE /L1CAMSR2_S5/
RECORD /SCANTIME/ ScanTime
REAL*4 Latitude(486)
REAL*4 Longitude(486)
RECORD /SCSTATUS/ SCstatus
BYTE Quality(486)
REAL*4 incidenceAngle(1,486)
BYTE sunGlintAngle(1,486)
BYTE incidenceAngleIndex(2)
REAL*4 Tc(2,486)
END STRUCTURE

```

```

STRUCTURE /L1CAMSR2_S4/
RECORD /SCANTIME/ ScanTime
REAL*4 Latitude(243)
REAL*4 Longitude(243)
RECORD /SCSTATUS/ SCstatus
BYTE Quality(243)
REAL*4 incidenceAngle(1,243)
BYTE sunGlintAngle(1,243)
BYTE incidenceAngleIndex(2)
REAL*4 Tc(2,243)
END STRUCTURE

```

```

STRUCTURE /L1CAMSR2_S3/
RECORD /SCANTIME/ ScanTime
REAL*4 Latitude(243)
REAL*4 Longitude(243)
RECORD /SCSTATUS/ SCstatus
BYTE Quality(243)
REAL*4 incidenceAngle(1,243)
BYTE sunGlintAngle(1,243)

```

```

        BYTE incidenceAngleIndex(2)
        REAL*4 Tc(2,243)
END STRUCTURE

STRUCTURE /L1CAMSR2_S2/
    RECORD /SCANTIME/ ScanTime
    REAL*4 Latitude(243)
    REAL*4 Longitude(243)
    RECORD /SCSTATUS/ SCstatus
    BYTE Quality(243)
    REAL*4 incidenceAngle(1,243)
    BYTE sunGlintAngle(1,243)
    BYTE incidenceAngleIndex(2)
    REAL*4 Tc(2,243)
END STRUCTURE

STRUCTURE /SCSTATUS/
    INTEGER*2 SCorientation
    REAL*4 SClatitude
    REAL*4 SClongitude
    REAL*4 SCaltitude
    REAL*8 FractionalGranuleNumber
END STRUCTURE

STRUCTURE /SCANTIME/
    INTEGER*2 Year
    BYTE Month
    BYTE DayOfMonth
    BYTE Hour
    BYTE Minute
    BYTE Second
    INTEGER*2 MilliSecond
    INTEGER*2 DayOfYear
    REAL*8 SecondOfDay
END STRUCTURE

STRUCTURE /L1CAMSR2_S1/
    RECORD /SCANTIME/ ScanTime
    REAL*4 Latitude(243)
    REAL*4 Longitude(243)
    RECORD /SCSTATUS/ SCstatus
    BYTE Quality(243)
    REAL*4 incidenceAngle(1,243)

```

```
        BYTE sunGlintAngle(1,243)
        BYTE incidenceAngleIndex(2)
        REAL*4 Tc(2,243)
END STRUCTURE
```

```
STRUCTURE /L1CAMSR2_SWATHS/
  RECORD /L1CAMSR2_S1/ S1
  RECORD /L1CAMSR2_S2/ S2
  RECORD /L1CAMSR2_S3/ S3
  RECORD /L1CAMSR2_S4/ S4
  RECORD /L1CAMSR2_S5/ S5
  RECORD /L1CAMSR2_S6/ S6
END STRUCTURE
```